



II CONGRESO
INTERNACIONAL
DE MINERÍA



Northern Light Technologies

Ventilation Optimization

N-Connex Networking for Harsh Environments



NLT – Experience | Quality | Service

- Since 1984, NLT has been providing innovative solutions to global mining and tunnelling markets
- Our parent company Levitt Safety has serviced the Canadian Safety markets since 1935
- In 2006, NLT became the first company in the world to deploy an I.S. Wi-Fi Network in an underground coal mine
- Offices in Canada, Australia, Chile, Germany. With our global presence across all continents, NLT has you covered
- Support is available to 24/7 in virtually any time zone around the world
- Production operations in Canada and Australia are ISO9001 certified
- NLT's distributor in Peru is Minera Almax S.A.C.



The Cost of Underground Ventilation

- One of the largest operating costs for an underground mine / tunnel is electricity
- One of the largest consumers of this electricity is a mine's ventilation system
- The electrical requirements of a ventilation system can account for 25% to 50% of a typical mine's entire electrical power cost



Optimizing a Mines Ventilation Solution

The Challenge

- Regulatory bodies dictate minimum underground air flow requirements for a mine
- To avoid expensive fines for violating legislated levels, many mines run their ventilation equipment at full capacity, exceeding the minimum air flow required

The Result

- Inefficient use of resources and very expensive

Goal

- To provide the optimum level of airflow in the mine / tunnel, where and when needed
- Reduce electricity usage
- Utilize existing infrastructure to minimize cost
- To create a safe environment for mine personnel



Ventilation Optimization - Project Profile

Brenner Base Railway Tunnel in Innsbruck, Austria.

- The largest transportation tunneling project in the world
 - 55km double track tunnels connecting Austria to Italy, through the Alps
 - Project started in 2008, with completion scheduled by 2026
- NLT is providing:
 - Ruggedized Wi-Fi network
 - Digital Voice Communications
 - Real-time personnel, vehicle and asset tracking
 - Remote airflow, particulate and gas monitoring
 - Surveillance Camera System
- Faced with crippling electrical costs, NLT worked with the tunnels engineers and ventilation equipment provider, Cogemacoustic, to design a solution that would optimize the tunnel's ventilation system using existing network infrastructure
- The result has been a dramatic reduction in electrical consumption and improved personnel safety



N-Connex: Networking for harsh environments

- Designed specifically for underground mining.
- Simple. Reliable. Rugged were key design criteria.
- User friendly rail based mounting system - Modules can be changed by Non-Technical personnel
- Modular – plug and play for easy maintenance, rapid deployment, redeployment and expansion.
- Pre-terminated IP67 Ethernet and Fibre cables
- Supplies power to POE devices, up to 400m away



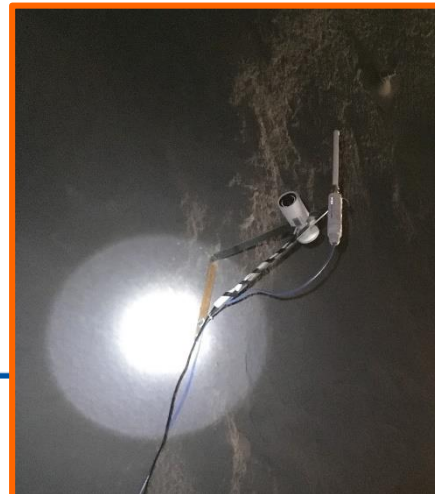
Network Backbone N-Connex



N-Connex: Core Network Modules

N-Connex Gigabit solution is an IP67, modular solution to support rapid installation, easy maintenance and full customisation. The core modules include:

- **Distribution** – the core Network Connectivity module featuring four (4) 1Gb fibre ports and eight (8) PoE Ports, plus two (2) non-PoE ports. With advanced network security features. All N-Connex receptacles are protected from impact by the proprietary enclosure design. Pre-terminated two (2) core fibre can be supplied to connect Distribution modules to the Network.
- **Bolt** – Our IP67 industrial strength 802.11 b/g/n Access Point features high power output, PoE support and a standard omni-directional antenna. The Bolt is connected to the Distribution module via Cat6 cable. The Bolt will track any WiFi (MAC) device. Typical coverage from a standard Bolt installation is 250-300m.



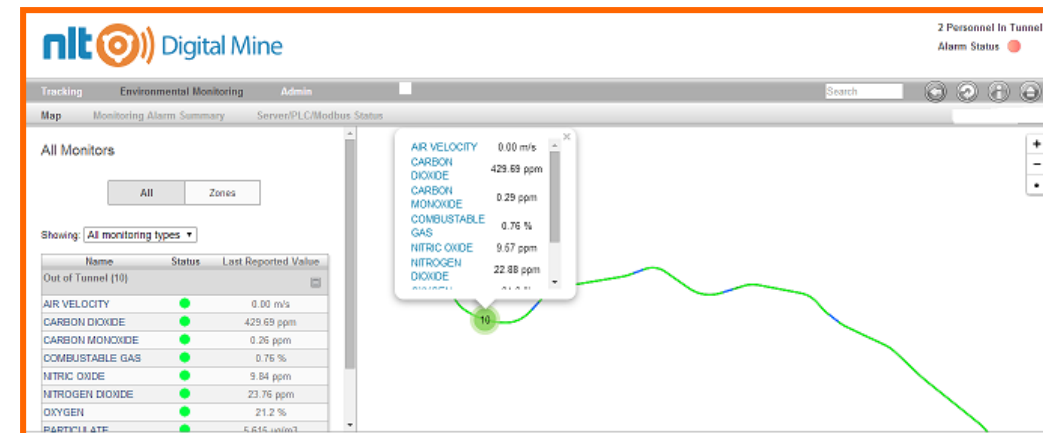
N-Connex: Core Network Modules

- **Power** – the core Power Connection module featuring 110-240 VAC input and 48 VDC output. The Power module can support up to two (2) Distribution modules or another module that needs 48VDC, eg. Digital (or Analog) IO.
- **Battery** – an optional module for Battery Backup at 48Vdc. While backup time will vary with load, a typical load will be supported for estimated 8-12 hours.
- **Extenders** – the N-Connex Extenders overcome the 100m limitation for Cat6 Ethernet cabling. The extenders increase the maximum distance of Cat6 cabling up to 400m.
- **Fibre and Cat6** – pre-terminated Fibre and Cat6 cables simplify installation and ongoing maintenance.



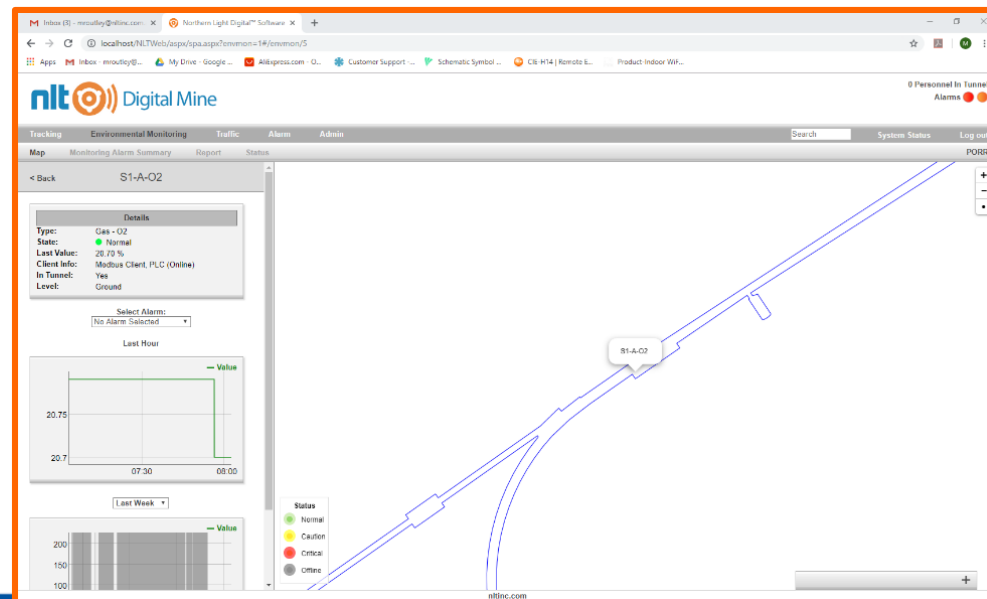
Monitoring – Ventilation, Airflow and Air Quality

- Measure air-flow and climate information in real time.
- Ultrasonic technology provides the highest level of accuracy and reliability in airflow measurement.
- The “cross-section averaging” approach ensures the true airflow through the whole section is measured.
- Climatrax can provide Temperature, Pressure, Humidity, Wet Bulb and Dew Point
- Climatrax can be fully integrated in to the core MAQS unit shown.
- Data can be provided in graphical and tabulated formats for review and trending purposes.



Monitoring – Gas and Environmental Conditions

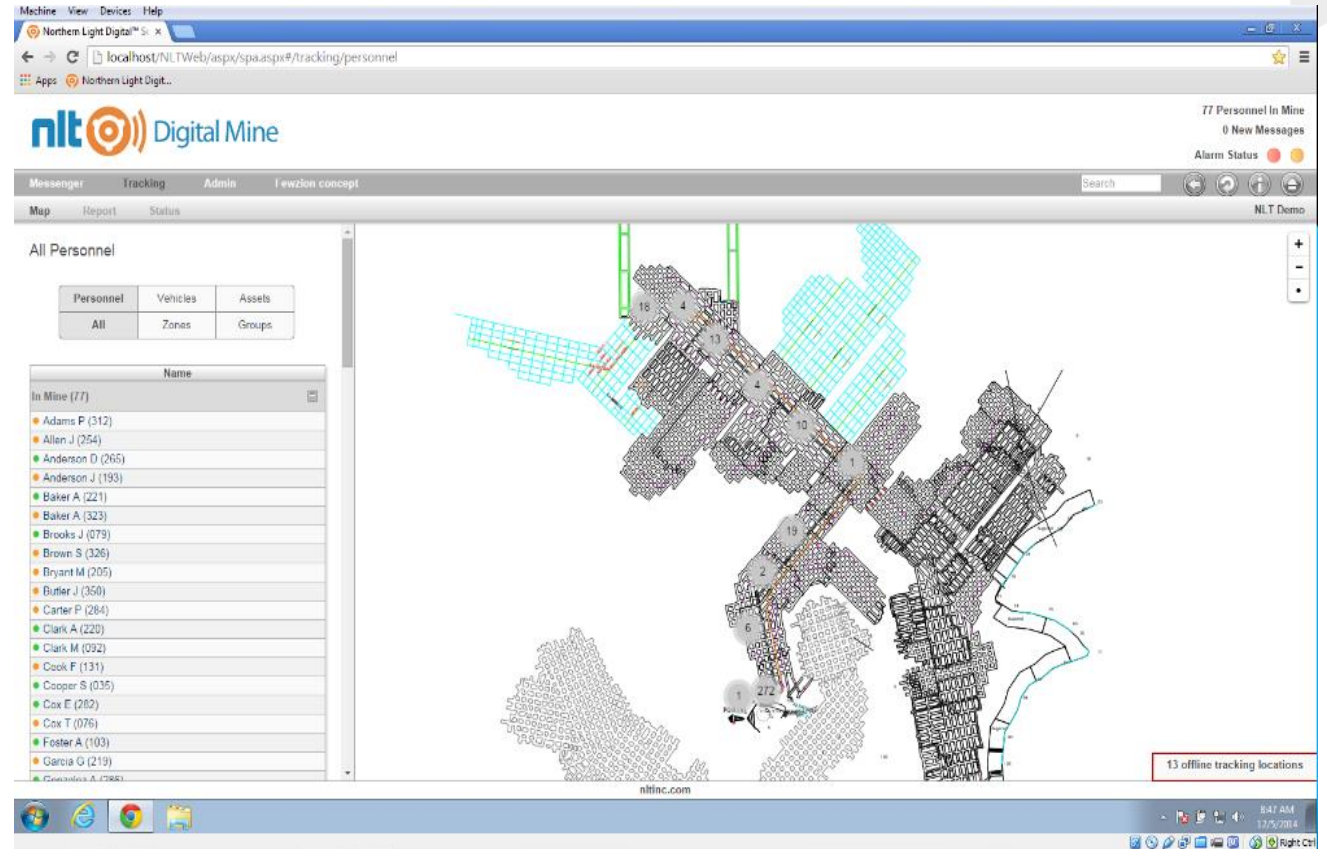
- Up to 8 gases monitored simultaneously.
- Dust particulate monitoring
- PoE and locally powered sensors available.
- Monitoring data imported into NLT Digital Mine via Modbus



NLT Digital Mine™ Software

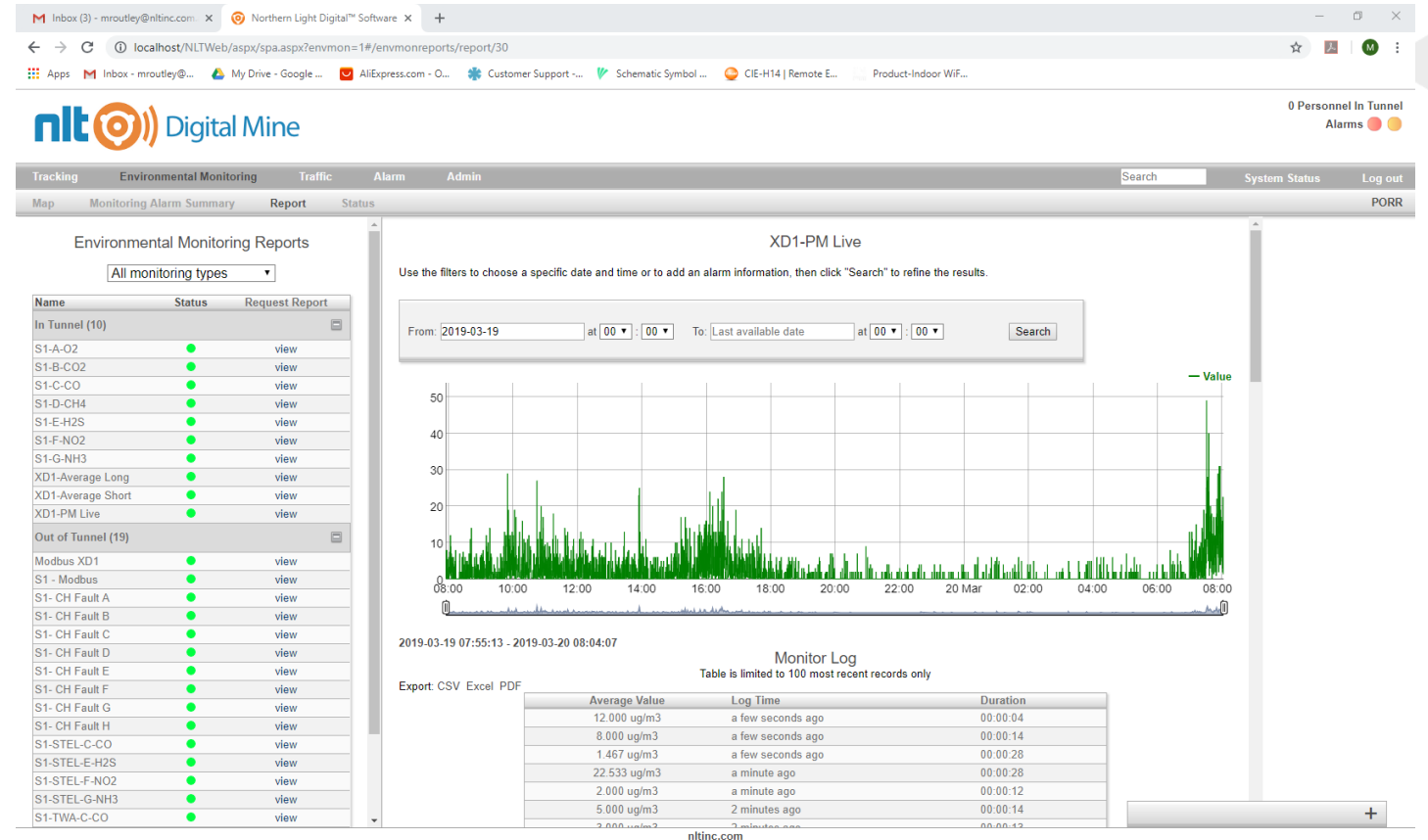
Management Software Solutions

- NLT Tracking software provides a simple Graphical User Interface.
- Utilize mine maps to provide accurate location information.
- Easily zoom in or out to get as much detail as desired. The example shows all personnel currently in the mine.
- Fully web-based solution.
- Screen scales to optimize viewing device
- Accurately tracks personnel, vehicles and assets, in real-time



Monitoring – Gas and Environmental Conditions

- Measure air-flow, humidity, gases, temperature, and particulate.
- PoE and locally powered sensors available.
- Connection to NLT Digital Mine via Modbus TCP.
- Data can be provided in graphical and tabulated formats for review and trending purposes.
- Alarms and notifications can be generated and managed



Emergency Application and Modules

- Digital Mine has a complete Emergency Management application.
- N-Connex modules include the Alarm (single strobe/siren) and Evacuation (two strobe/sirens) Modules.
- Modules have 110dB sirens, activation buttons, momentary mute buttons to enable a range of capabilities to suit each client' specific needs.
- All N-Connex modules are PoE and with Extenders can be installed up to 400m from the Node.



Emergency Application and Modules

The screenshot displays the 'nlt Digital Mine' emergency application interface. At the top right, it shows '0 Personnel In Tunnel' and 'Alarms'. The navigation bar includes 'Tracking', 'Environmental Monitoring', 'Emergency', and 'Admin'. Below this, there are tabs for 'Map', 'Report', and 'Status', along with a search bar and 'System Status' and 'Log out' options. The main content area is titled 'N-Connex Alarms' and features a 'Start Site Evacuation' button. A table lists various tunnel zones with their names and status indicators (green dots). A map on the right shows a network of tunnels with a red line indicating an active alarm zone. A popup window provides details for the alarm: 'Alarm : Zugangstunnel 4.1 TM 1700', 'Zone: Ground', 'Last Online: Jul 01, 2019 12:56', 'State: off', and 'Status: Online'. It also includes 'Start Warning' and 'Start Evacuation' buttons.

0 Personnel In Tunnel
Alarms

Tracking Environmental Monitoring Emergency Admin Search System Status Log out

Map Report Status PORR

N-Connex Alarms

Zones All

Start Site Evacuation

Name	Status
EKS-Rampe	●
EKS-S 1.1	●
EKS-S 2.2	●
Mittelstollen 1.1	●
Padastertal Tunnel 1.1	●
Padastertal Tunnel 2.1	●
Schutterstollen 1.1	●
Schutterstollen 2.1	●
Zugangstunnel 1.1 TM 130	●
Zugangstunnel 2.1 TM 660	●
Zugangstunnel 3.1 TM 1160	●
Zugangstunnel 4.1 TM 1700	●
Zugangstunnel 5.1 TM 2240	●
Zugangstunnel 6.1 TM 2750	●
Zugangstunnel 7.1 TM 3300	●

Alarm : Zugangstunnel 4.1 TM 1700

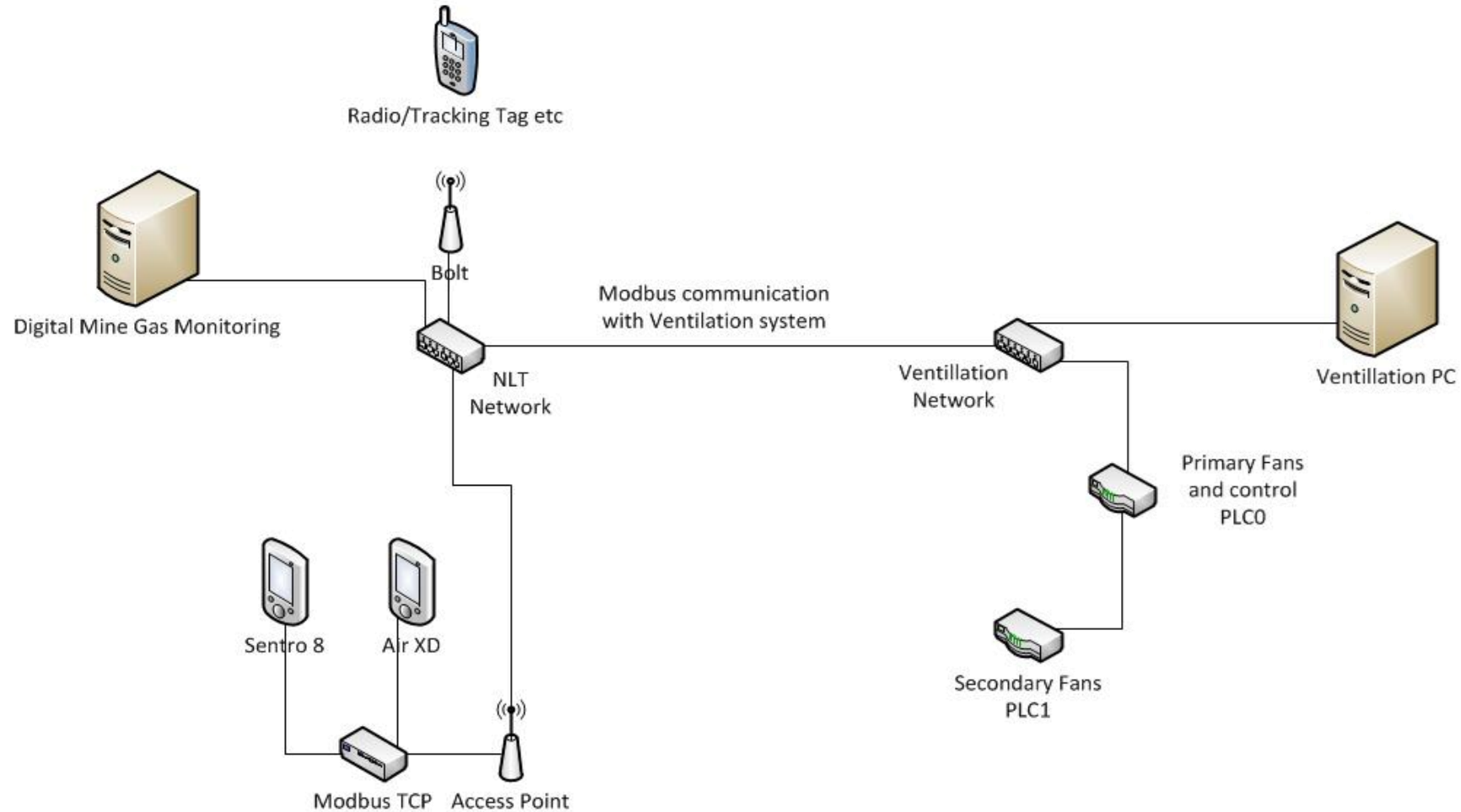
Zone: Ground
Last Online: Jul 01, 2019 12:56
State: off
Status: Online

Start Warning Start Evacuation

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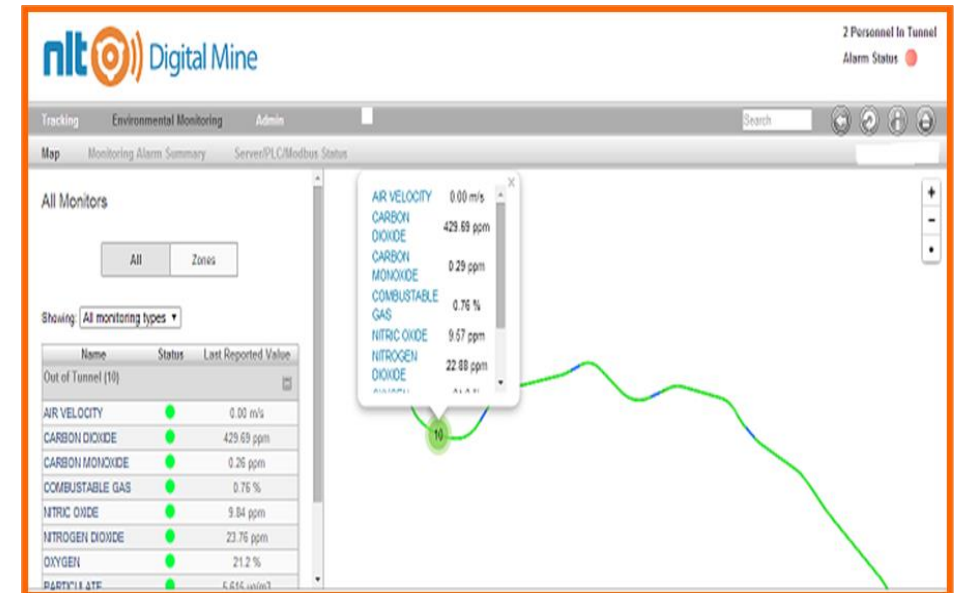
Digital Mine Ventilation Visualization

Control Topology



Ventilation Optimization

- Digital Mine becomes the epicenter for optimizing the ventilation system.
- The Digital Mine Event Composer combines information from the tracking server, environmental module, Cogemacoustic and alarm module to allow the customer to specify when they want to ventilate an Area/Zone, or to stop ventilation when not required, while making sure the minimum legislated flow levels are maintained.
- Digital Mine communicates with the ventilation control system to gather data; which fans are running, fan speed etc. It then quantifies all the acquired data, sending basic commands for the ventilation control system that are used to optimize fan operation.
- All parameters are fully configurable.



Ventilation Optimization

Data required for Ventilation Optimisation

Environmental monitoring

- Trolex Sentro 8 / NLT Digital Mine Software

Particulate monitoring

- Trolex AirXD / NLT Digital Mine Software

Air flow monitoring

- Accutron Ultra Sonic / NLT Digital Mine Software

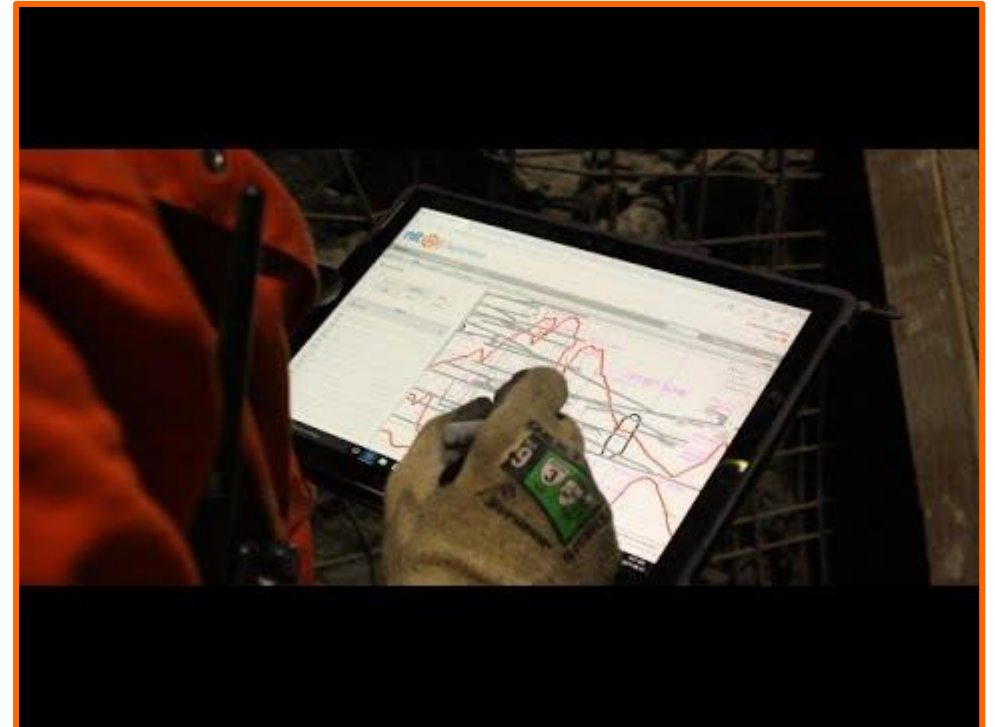
Personnel & Vehicle tracking

- Aeroscout Wi-Fi tags / NLT Digital Mine Software

Ventilation Zones

- NLT Digital Mine Software

Actual control of ventilation infrastructure (fans) is controlled by the ventilation equipment provider 100% of the time



Ventilation Optimization

Examples of how incorporating ventilation optimisation into a Mine will reduce energy usage and more importantly increase safety:

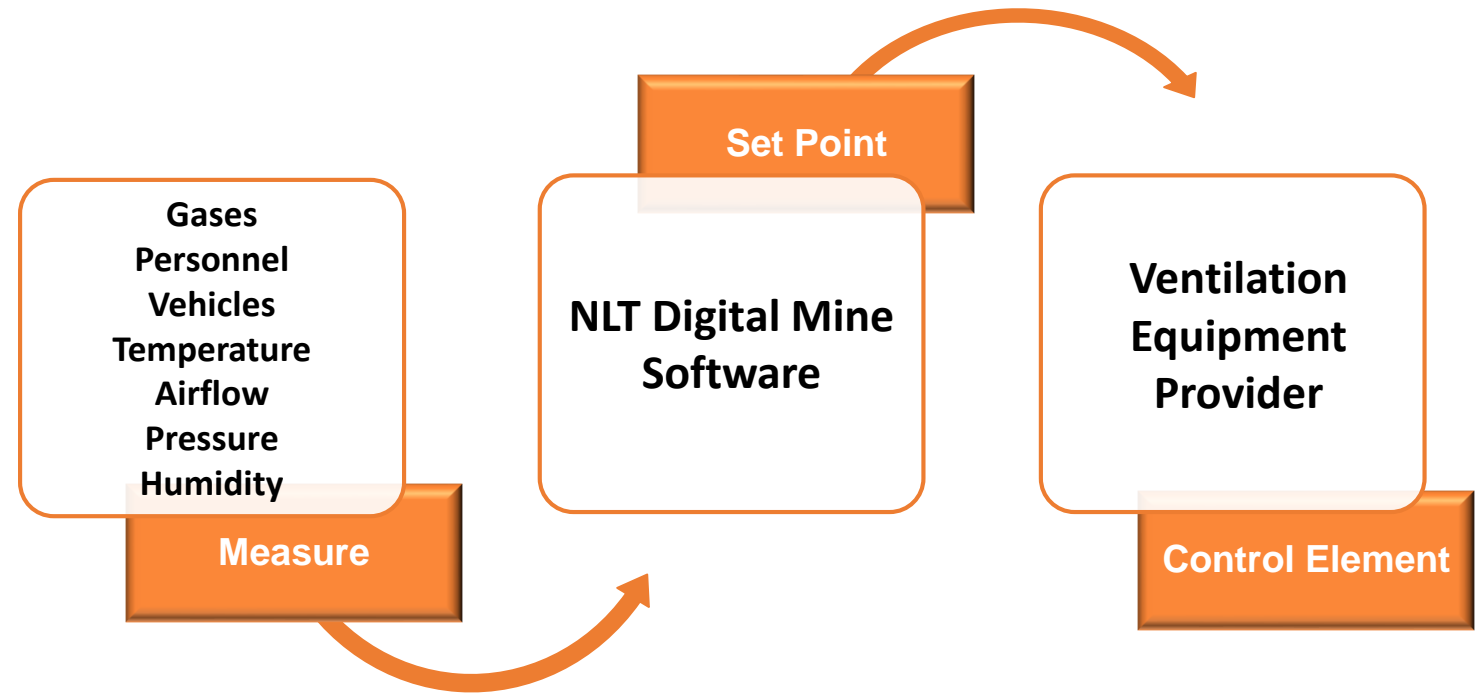
Ventilation Scenarios

- There are 3 personnel in ZONE 1. DM will recognize that and send the command to turn on the fan for that area.
- There are no personnel in ZONE 2. DM will recognize that and send the command to turn off the fan for that area.
- There is a high H₂S alarm in ZONE 7. DM will send the command to turn up the fan to facilitate ventilation in the area and decrease Airflow once the levels return to normal levels.
- There is a fire alarm in ZONE 4. DM will send the command to shut down ventilation.
- There is High level dust Alarm in Zone 2. DM will increase airflow until the levels have decreased
- Multiple vehicles/Plant are in Zone 1. creating diesel fumes. DM will increase the ventilation to dilute diesel emissions
- Ensures minimum legal limits of Air flow are adhered to

Ventilation Optimization

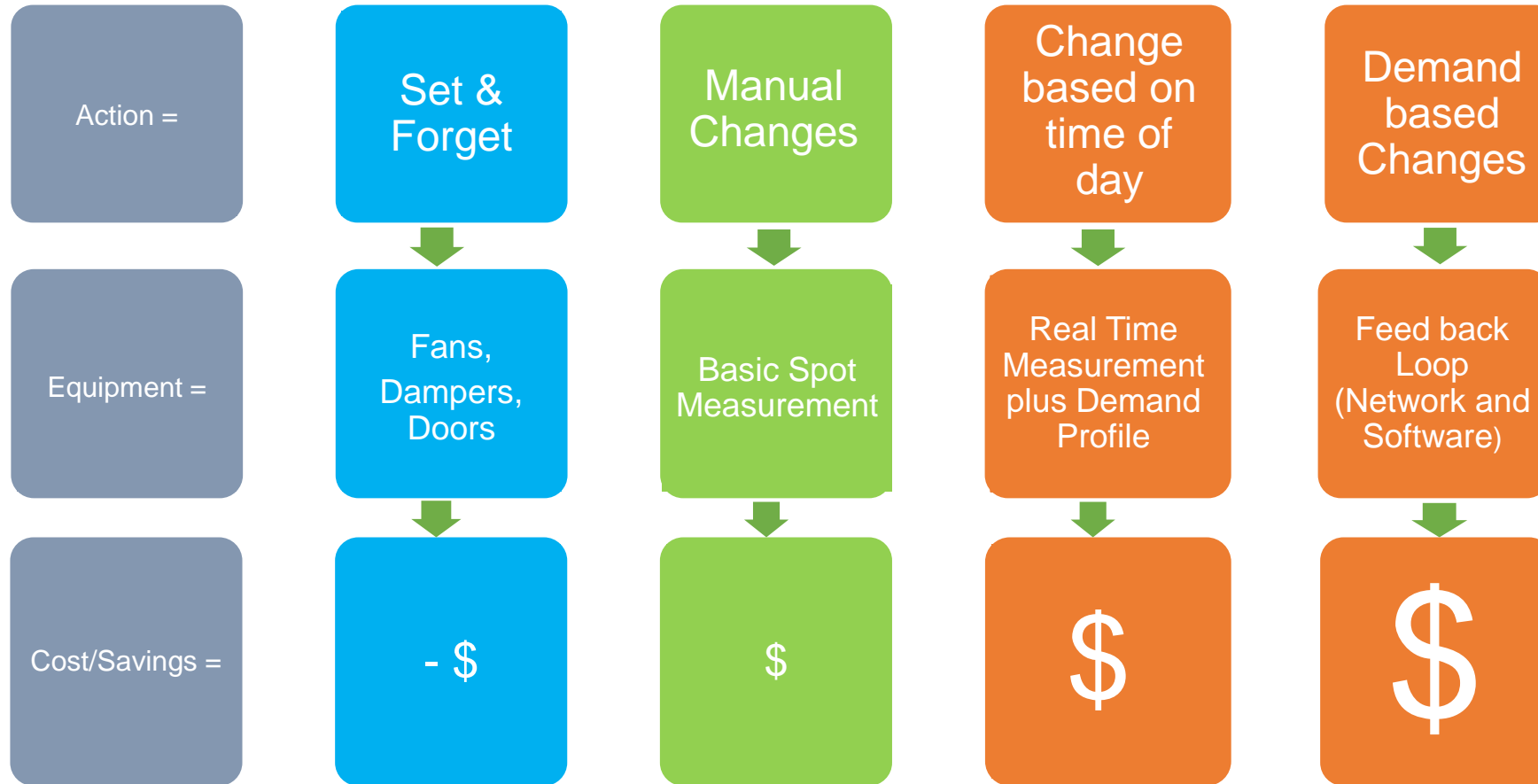
The Ventilation “Trinity”

- Measurement is the key decisionable data
- Once you measure you can decide on settings (mandated and optional)
- Then you can decide how to control the Set Points



Ventilation Optimization

Optimization vs On Demand Energy Savings





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